I have not changed the specification and the original art work in support of the specification except to correct my errors and to add the cellular network application as supporting figures to the existing 7 figures.

1. Yang (US 6,674,712)

Yang combines the quaternary complex-valued Kerdock codes with the real Walsh codes to generate a set of quasi-orthogonal CDMA codes. Prior art represented by the paper by Hannon et. al. (IEEE Trans. Inform. Theory, vol. 40, pp. 301-319, 1994) and other prior publications derive the Kerdock codes with the same permutation and algorithm presented in this patent.

Yang (FIG. 3, FIG. 4, 519 in FIG.5, FIG. 10, FIG. 11) combines the set of (2^m-1) Kerdock codes of length (2^m-1) with zeros added at the start to extend their length to 2^m, with the set of 2^m real Walsh codes of length 2^m using modulo 4 addition to generate the set of $(2^m-1)*2^m$ quasi-orthogonal codes of length 2^m. The Walsh codes in digital format 0,1 are multiplied by the factor 2 prior to addition with the Kerdock codes in the 0,1,2,3 quaternary format. This code combining of the Kerdock codes with the Walsh codes is an algebraic addition of the Kerdock and real Walsh codes which is mathematically identical to covering the real Walsh codes with the real and complex components of the Kerdock codes to generate a set of complex-valued quasi-orthogonal CDMA codes.

Only $N=2^m$ of the $(2^m-1)*2^m$ codes that Yang creates can be used since basic communication theory ("Digital Communications", by Proakis, 1995 McGraw-Hill) and linear algebraic theory ("Linear Algebra", by Friedberg, Insel, and Spence, 1979 Prentice Hall) teaches us that the communications

frequency-time space occupied by codes of length of 2^m is uniquely spanned by $N=2^m$ codes. Correlation bounds equivalent to Yang's equations (1),(2),(3),(4) are used in current art to help select the N codes.

Unlike Yang, current CDMA art uses the same 2^M PN (pseudo-noise) code for all real Walsh channelization codes which keeps the orthogonality property while providing the desired low correlation sidelobe properties that should meet these bounds.

Current art uses real and complex pseudo-noise (PN) codes, Gold codes, Kasami sequences, Golay codes, and Kerdock codes for spreading and covering of the real Walsh channelization codes. A 2^m chip code length will support $N=2^m$ independent codes and for CDMA this family of 2^m codes are the orthogonal real Walsh channelization codes covered (spread) with quasi-orthogonal PN codes, Gold codes, Kasami sequences, Golay codes, and Kerdock codes.

Yang (col. 6, lines 14-17, 28-32) restates the current art that an M-sequence with an added 0 at the beginning in FIG. 3 becomes a real Walsh code under a column permutation. This column permutation is a re-arrangement of the M-sequence 0,1 values to coincide with the 0,1 values for the real Walsh when expressed in digital format taking the values 0,1. M-sequences are real shift register sequences with 0,1 digital values of length (2^m-1) with the property that the number of 0's and 1's differs by 1. M-sequences referenced by Yang are Gold codes, Kasami sequences, and Kerdock codes.

Yang does not use complex Walsh codes and does not address the generation of larger families of combined Walsh and DFT (discrete Fourier transform) codes.

2. Baum (Pub. No. US 2002/0126741 A1)

Baum performs equalization on the received CDMA signal from the M receive antennas 1,2,…,M in the frequency domain by taking the fast Fourier transform (FFT) or DFT in Equation (12) of the received CDMA signal after it has been matched filter detected, performing the linear equalization on the discrete harmonic components of the received signal in Equation (14) over the transmitted data block after the cyclic redundancy has been removed, performing the inverse FFT (IFFT) or inverse DFT (IDFT) on the equalized frequency components of the received date block, and then proceeding to recover the transmitted QAM or PSK data in FIG. 3 and FIG. 4 by stripping off the long code which covers the real Walsh code followed by real Walsh code despreading to recover the transmitted data symbols. The CDMA signal Baum encodes QAM or PSK data with real Walsh channelization codes, sums the channelization codes for each chip, covers the real Walsh encoded complex data stream with a long code, and filters this complex data stream prior to up-converstion and transmission consistant with current CDMA art.

Baum (paragraph 48, 49) strips off the cyclic redundant chips from the received data block after being matched filtered detected and represents the received detected data chips in Equation (11) including the propagation path time delay and gain impacts on the detected chips, and performs a DFT in Equation (12) on this received data block to transform it to the frequency domain for equalization.

Baum does not use complex Walsh codes and does not address the generation of larger families of combined Walsh and DFT (discrete Fourier transform) codes.
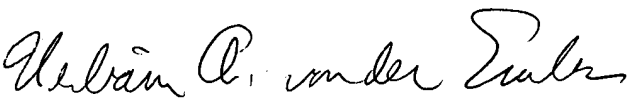
4

3. Li (US 6,389,138)

Li uses the (2^42-1) bit long code generator output for the inphase component and a delayed output for the quadrature component to generate a complex long code for CDMA applications. This innovation applies a code principle previously used in IS-95A,B that strips of code from a shift register code generator are statistically independent when the strips are sufficiently separated. Complex short codes already exist for CDMA. Real Walsh codes are used for channelization codes for user traffic and communications housekeeping functions that include pilot signals, control channels, supplemental channels, reverse channels. These codes are used for both the inphase and quadrature components of the complex signal. The resulting real Walsh channelized signal set is then complex encoded with the complex long code and complex encoded with the complex short code.

Li does not use complex Walsh codes and does not address the generation of larger families of combined Walsh and DFT (discrete Fourier transform) codes.

Thanks ever for your welcomed help and guidance with this patent application.

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